

Printed-Wiring Board Continuity Test File Specification

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ABSTRACT: This document details the file contents and format for a PWB product Continuity Test File (CTF). A CTF provides a method for organizing and transferring complete product network connectivity data between Design and Manufacturing functions. CTFs are required elements of Digital's 50-level data sets for all products that require data-driven continuity testing. CTF data shall be used by PWB fabricators as final product acceptance criteria for Digital PWBs.

APPLICABILITY: This document is mandatory for personnel responsible for testing high-technology PWBs that require data-driven continuity testing.

STATUS: APPROVED 17-Jul-1990; use VTX SMC for current status.

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1 INTRODUCTION

This specification defines the structure, data definitions, and limitations of a Continuity Test File (CTF). CTF is the file type that will be used to transfer product network connectivity information between Design and Manufacturing functions. Boards Manufacturing uses this information for electrical testing of a printed-wiring board (PWB), including continuity and isolation compliance testing. Target test boards are completed composite through-hole technology PWBs, including Surface Mount Technology (SMT) products.

This specification establishes CTFs as required elements of Digital 50-level data sets for all products that require data-driven continuity testing.

The intent of this specification is to define a file format that allows CTFs to provide a method for:

- Transferring complete product network connectivity data between Design and Manufacturing
- Organizing data that is required by data-driven bare board continuity test equipment
- Organizing data that allows translation by Manufacturing to support the specific data requirements of different types of electrical testers

This specification will be updated when necessary to reflect new PWB test process requirements or product technology specifications.

2 VERIFYING CONTINUITY

For the purpose of this specification, continuity shall be defined as electrical connectivity between endpoints of a network.

The CTF will provide test data for verifying continuity of all circuitry within the shippable area of the PWB, such as in-circuit test coupons and non-functional plated holes. Test data will not be provided for product information areas such as the part number, Digital logo, and UL block or for areas outside the circuitry such as tooling holes, test coupons, and other areas.

Embedded planar-passive components within a particular physical network, such as resistors and capacitors, shall not be considered as part of that network. Embedded devices shall be represented as having two different networks on opposite ends of each discrete device.

Unused pins or points that intentionally do not have connectivity to other points shall be defined as single point networks. Test data for these points shall be included in the CTF.

3 FILE TRANSFER

Easynet and various Data Management Systems such as the Manufacturing Data Access System (MDA) and the Product Information Management System (PIMS) are the preferred vehicles for transferring CTFs between design sites and manufacturing plants.

4 FORMAT CONVENTIONS

The following format conventions are required for CTFs. Refer to heading 9 for external supplier requirements.

- Use VAX/VMS ASCII file format conventions.
- End each line with a VAX Record Management Services (RMS) variable length implied-carriage return.
- Use the Digital Multinational character set.
- Separate each data field with a comma.

5 FILE STRUCTURE

A CTF shall consist of three different record types.

- a. Connectivity Record
- b. Continuation Record
- c. Extension Record

Other elements of a CTF include File Header information, an End of File indicator, and Remark Lines.

The following subheads describe the three types of records and the other elements of a CTF.

5.1 Connectivity Record

The Connectivity Record includes the following data fields, which provide the feature dimension characteristics of a connectivity group. Refer to subhead 6.1 for data element definitions.

CONN,PAD,DIM1,DIM2,HOLE,SM,SIDE,EPT,USE,SIGNAME

The characteristics defined by the Connectivity Record apply to all X,Y coordinates named in the subsequent Continuation Records until the next occurrence of a Connectivity Record.

The first character of the Connectivity Record must be an equal sign (=), which is substituted for the data field, CONN. For example:

=,PAD,DIM1,DIM2,HOLE,SM,SIDE,EPT,USE,SIGNAME

where:

PAD is one of the following network node feature shapes.

- Circular Pad
- Square Pad
- Rectangular Pad
- Oval Pad
- Polygon Pad
- Donut Pad

DIM1 is the X dimension of the PAD.

DIM2 is the Y dimension of the PAD.

HOLE is the nominal hole diameter at the network node.

SM denotes whether the node can be probed by defining the node as covered or tented.

SIDE identifies the side from which the network node feature is testable.

EPT denotes whether a test point is a network endpoint.

USE is the test point physical description.

Surface mount component pad
 Component pad
 Feed thru/via
 Test probe point
 Finger/Zif connector

SIGNAME is the circuit signal name.

5.2 Continuation Record

A Continuation Record names and locates the test points.

The first character of a Continuation Record must be an X, and the field may contain from 1 to 5 coordinate pairs.

Grouping X,Y coordinates under common feature sizes that are defined by the DIM1 and DIM2 variables produces a more compact file, but coordinate grouping is not a requirement of this specification. The following example shows both ungrouped and grouped coordinates.

X, Y, X, Y, X, Y, X, Y, X, Y	or	X, Y
		X, Y
		.
		.
		.
		X, Y

where:

X is the network node X-location (feature shape centroid), referenced from the H-Master Zero datum.

Y is the network node Y-location (feature shape centroid), referenced from the H-Master Zero datum.

5.3 Extension Record

An Extension Record redefines the feature dimensions of a connectivity group. The Extension Record uses the same data fields as the Connectivity Record except for the signal name, which is not repeated. Refer to subhead 6.1 for data element definitions.

CONN,PAD,DIM1,DIM2,HOLE,SM,SIDE,EPT,USE

The first character of an Extension Record must be a plus sign (+). For example:

+,PAD,DIM1,DIM2,HOLE,SM,SIDE,EPT,USE

Identical extension lines may occur repeatedly within one connectivity group.

5.4 File Header Information

File Header information shall be included in the CTF as Remark Lines (subhead 5.5). Required file header information includes the 50-class part number, etch revision, test file identification, and specification compliance. Additional information is also recommended. For example:

```
; Continuity Test File
; Complies with CTF File Spec, A-SP-ELMF721-00-0, Rev AX04, 22-May-90
; Project Name : Eagle
; Module number : T2015_00_H05
; Board number : 50-17457-01 F01
; Generation date: 2-AUG-1989
; Source Node : CADSE
; Source file : 5017457_01_F01_DES_ENG.ADS_FULL
; Producibility Engineer: John Hancock
; Max EPT density : 136 points/sq in
```

NOTE

The Source File may be any archivable product data base such as ADS, MDB, PDF, WDS, and others.

5.5 Remark Line

The first character of a Remark Line must be a semicolon (;) character.

A Remark Line may contain a maximum of 64 characters, excluding the semicolon.

General remarks are optional and can appear anywhere throughout the file.

5.6 End of File Indicator

The end of file indicator must be the period (.) character in the first position of the last line.

6 DATA DEFINITIONS

The following subheads provide detailed definitions of Connectivity, Continuation, and Extension Record data fields.

6.1 Connectivity Data

The following data element definitions apply to both Connectivity and Extension Records, except for SIGNAME, which is not included in Extension Records. Refer to subheads 5.1 and 5.2 for descriptions of the data fields.

PAD or feature shape shall be expressed by a single alpha character. Valid entries are C (circular), S (square), R (rectangular), O (oval), P (polygon), or D (donut) entries.

DIM1 is the X dimension of the network node feature PAD shape.

- For D PAD shapes, DIM1 shall be the outer diameter.
- For padless holes, DIM1 shall be zero.

DIM2 is the Y dimension of the network node feature PAD shape.

- For D PAD shapes, DIM2 shall be the inner diameter.
- For C and S PAD shapes, DIM2 shall be identical to DIM1.

NOTE

For polygon shaped pad areas, DIM1 and DIM2 shall describe the largest periphery dimensions for a rectangular area within the polygon shape or the testable area. For polygon shaped areas with a hole, only the hole location shall be defined with a zero pad size.

HOLE is the nominal hole diameter at the network node. If no hole exists at the network node, the value of HOLE shall be zero.

DIM1,DIM2,HOLE shall be expressed in hundredths of mils (0.00001 inch) with a field length of 7 numeric characters and trailing zeros not suppressed. For example:

9999999,9999999,9999999

SM defines whether the network node is covered or tented with a soldermask or other conformal coating. SM shall be expressed as a single-character alpha: Y or N.

SIDE identifies the side from which the network node feature is testable. SIDE shall be expressed as a two-character alpha: SN or TH.

- SN denotes side number, S1 or S2.
- TH denotes a through hole testable from both Side 1 and Side 2 of a composite (completed) board.

EPT identifies the network endpoint. EPT shall be expressed as an asterisk (*) if the test point is an endpoint, or blank if not an endpoint.

USE provides the test point physical description. USE shall be expressed as a single alpha character: U (Surface mount component pad), P (Component pad), F (Feed thru/via), T (Test probe point), or C (Connectors - finger/zif connector)

SIGNAME, the signal circuit name, shall be expressed as 60 or fewer alpha characters. This name must be unique throughout the entire CTF file for a particular product. Circuit signal names with more than 60 characters shall be truncated.

6.2 Test Point Coordinate System Rules

For S1 oriented, S2 oriented, and double-sided testing, XY coordinates must be defined from the Digital "H-Master Zero" manufacturing datum point from side 2 of the PWB. All network node coordinates shall be represented by a positive-value-only coordinate system.

See Figure 1 for more detail.

6.3 Test Point Definition

All X,Y points named in the Continuation Record shall be tested for continuity as defined under heading 2 of this specification.

X and Y locations will be expressed in alphanumeric fields in hundredths of mils (0.00001 inch) and will have a field length of 8 characters with no trailing zero suppression. The X and Y fields will appear as:

X9999999,Y9999999

The points described in the CTF shall consist of all network nodes, including network endpoints and internodal points of each etch network accessible from Side 1 or Side 2 of the PWB. In general, a network endpoint is defined as any contact/via point which could be isolated if an "open" in an etch network occurred. For this reason, all component through-pin locations, all surface mount component contact pads, and all unused single point network locations are defined as endpoints. Intermediate vias in a network are usually not identified as network endpoints.

XY coordinates for through-pins or vias are located in the center of the drilled hole or pad. Surface Mount Technology (SMT) endpoint locations are located at the XY coordinates of the pad center.

6.4 Endpoint Density Definition

The maximum endpoint density for each product CTF file shall be the maximum number of endpoint nodes in a one square inch area surrounding each endpoint defined in the CTF. This maximum value shall be included in the File Header Information of the CTF. Refer to subhead 5.4 for a sample of File Header Information.

This maximum endpoint density value shall be used as a reference in determining circuit test density.

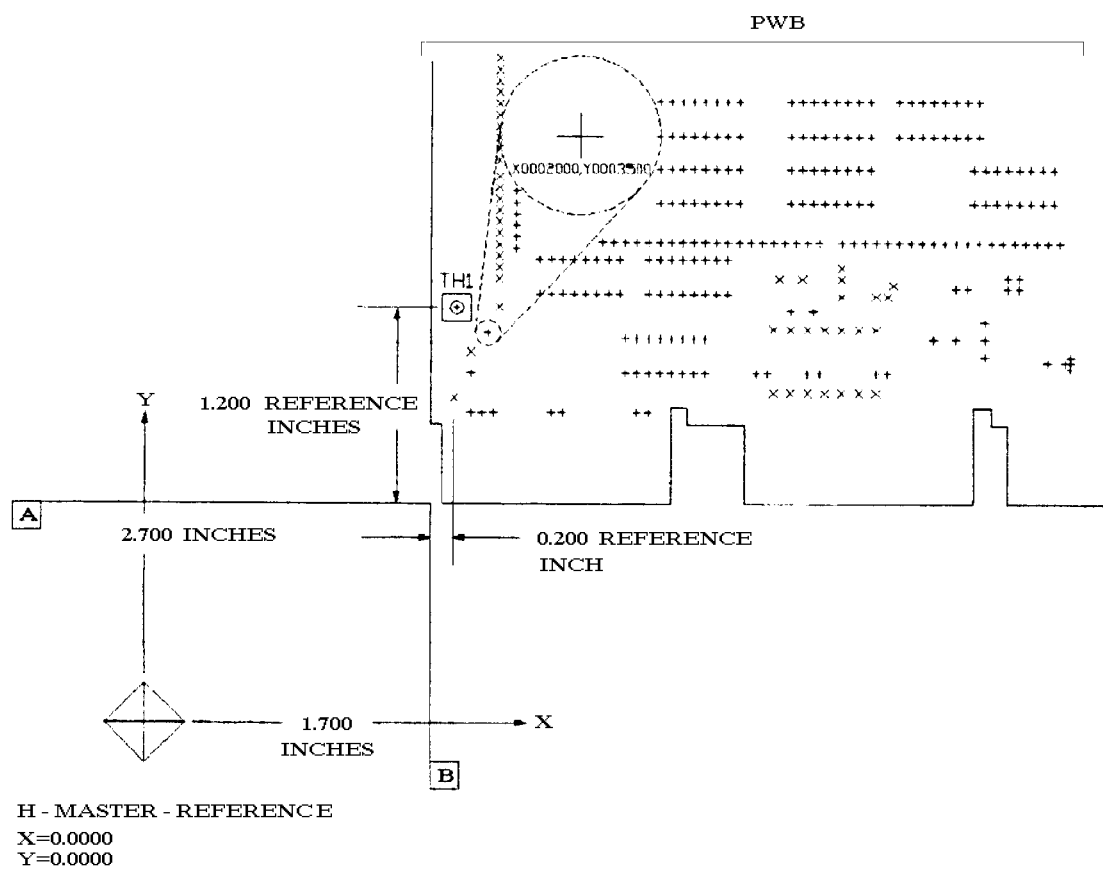
7 FILE LIMITATIONS

Data for all network nodes, as defined in subhead 6.3, shall be included in the PWB CTF. If a specific testing process has a test point limit, the manufacturing data user may subdivide the CTF.

There is no minimum probe separation requirement, but it is expected that the local test point density will not exceed 200 points-per-square-inch in the circuit/test area of the board. The 200 points-per-square-inch limitation represents the current industry Automated Test Equipment (ATE) equipment capability and is subject to change. The File Header information in each CTF must include the maximum local network endpoint density of the PWB.

Critical contact areas, as defined by product specific standards and *DEC STD 176-0 Printed-Wiring Board Acceptance Criteria* shall not be identified in the CTF. Critical contact areas such as gold or tin lead fingers/contacts shall be identified as network endpoints. It is the responsibility of the PWB manufacturer to either probe the next testable point in the network adjacent to the critical area or test the critical contact area and meet all DEC STD 176-0 surface finish requirements.

Figure 1: Digital "H Master Zero" Datum Coordinate System



8 SAMPLE CTF

```
; Continuity Test File
; Complies with CTF File Spec, A-SP-ELMF721-00-0, Rev A, 22-July-90
; Project Name : Eagle
; Module number : T2015_00_H05
; Board number : 50-17457-01 F01
; Generation date: 2-AUG-1989
; Source Node : CADSE
; Source file : 5017457_01_F01_DES_ENG.ADS_FULL
; Producibility Engineer: John Hancock
; Max EPT density : 136 points/sq in
=,O,0007500,0001600,0002000,N,S1,*,T,%DIS1000
X0407500,Y0864700
+,C,0002500,0002500,0002000,N,TH, ,T
X0405000,Y0885000
=,O,0007500,0001600,0002000,N,S1,*,T,%DIS1002
X0562500,Y0530000
+,C,0002500,0002500,0002000,N,TH, ,T
X0555000,Y0530000
=,O,0007500,0001600,0002000,N,S1,*,T,%DIS1003
X0562500,Y0532500
+,C,0002500,0002500,0002000,N,TH, ,T
X0550000,Y0530000
=,O,0007600,0003000,0002000,N,S2,*,T,%LED2128
X0675000,Y0617500
+,C,0003000,0003000,0002000,N,S2, ,T
X0675000,Y0625000
=,O,0007600,0003000,0002000,N,S2,*,T,%LED981
X0675000,Y0527500
+,C,0003000,0003000,0002000,N,S2, ,T
X0695000,Y0525000
=,O,0007600,0003000,0002000,N,S2,*,T,%LED982
X0675000,Y0572500
+,C,0003000,0003000,0002000,N,S2, ,T
X0690000,Y0570000
=,O,0007600,0003000,0002000,N,S2,*,T,%LED983
X0715000,Y1027500
+,C,0003000,0003000,0002000,N,S2, ,T
X0735000,Y1030000
=,O,0007600,0003000,0002000,N,S2,*,T,%LED984
X0715000,Y1117500
+,C,0003000,0003000,0002000,N,S2, ,T
X0715000,Y1125000
=,O,0007600,0003000,0002000,N,S2,*,T,%LED985
X0425000,Y0707500
+,C,0003000,0003000,0002000,N,S2, ,T
X0420000,Y0715000
.
```

9 FORMAT REQUIREMENTS FOR EXTERNAL PWB SUPPLIERS

The following subheads provide media format and file format requirements for external PWB suppliers.

9.1 Media Format

Standard media for CTF test data files shall be double-density 1.2 megabyte formatted 5.25 inch diskettes. Diskettes shall be IBM/AT[™] compatible, MS-DOS[®] V3.1 or higher. Diskettes shall be divided into 80 tracks (numbered from 0 to 79) with 15 sectors per track. Files are also available on 0.5-inch wide, nine-track magnetic tape (1600 BPI) with ANSI-standard format and labels.

9.2 File Format Conventions

Files shall be formatted as MS-DOS (V3.1 or higher) ASCII text files. Each line in the file shall end with an ASCII carriage return and line feed.

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[®] MS-DOS is a registered trademark of Microsoft Corporation

APPENDIX A REFERENCED DOCUMENTS

A.1 EL-Class Digital Documents

EL-Class Number	Document Title
EL-00176-00	<i>DEC STD 176-0 Printed-Wiring Board Acceptance Criteria</i>

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